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WITNESS my hand this
Fourth day of May 2006

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Cochlear Limited

PROVISIONAL SPECIFICATION

Invention Title:

Modular, interchangeable user interface for hearing prostheses

The invention is described in the following statement:

Field of the Invention

The present invention relates to hearing prostheses and in particular to a cochlear implant hearing system.

Background of the Invention

Cochlear implant hearing systems deliver electrical stimulation to the auditory nerve fibres thereby allowing the brain of a system recipient to perceive a hearing sensation resembling the natural hearing sensation normally delivered by the auditory nerve.

Such systems have typically comprised an external component and an implantable internal component that cooperate together to provide the sound sensation to the recipient. The external component generally comprises a microphone for detecting sounds, such as speech and environmental sounds, a speech processor unit that converts the detected sounds, particularly speech, into a coded signal, a power source, such as a battery, and an external transmitter antenna. The coded signal is transmitted transcutaneously to the internal component. The internal component comprises a receiver antenna, a receiver/stimulator unit, and an intracochlear electrode assembly.

The speech processor unit has traditionally been worn on the body, such as by being attached to clothing, or by being supported on the ear of the recipient. The speech processor unit is relatively expensive and generally must undergo an optimisation procedure following implantation of the implantable component of the system to ensure it suits the needs of the recipient. As such, most recipients only generally receive one speech processor unit. This can often result in the recipient or their carer having to compromise in the type of speech processor unit that they can use. The present invention is directed to a hearing prosthesis, such as a cochlear implant hearing system, that may provide recipients with a relatively greater degree of flexibility in how they can utilise the speech processor unit of their prosthesis.

Any discussion of documents, acts, materials, devices, articles or the like which has been included in the present specification is solely for the purpose of providing a context for the present invention. It is not to be taken as an admission that any or all of

these matters form part of the prior art base or were common general knowledge in the field relevant to the present invention as it existed before the priority date of each claim of this application.

Summary of the Invention

Throughout this specification the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated element, integer or step, or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

According to a first aspect, the present invention is a hearing prosthesis system comprising:

a first housing containing a speech processor that receives signals output by a microphone; and

a plurality of second housings that are removably connectable to the first housing;

wherein only one of said second housings is connectable to said first housing at any one time and further wherein at least one of said second housings has a user interface that provides control of one or more features of the operation of the speech processor.

In one embodiment of this aspect, one or more of said plurality of second housings can contain a power supply for at least some of the components of the prosthesis.

In another embodiment, one or more of said plurality of second housings can contain a power supply and have a user interface that provides control of one or more features of the speech processor.

In yet another embodiment, one or more of said plurality of second housings can be connectable by an electrically conducting lead to a remote module housing a power supply. This second housing can be provided with a user interface on the second housing. In another embodiment, a user interface can be provided on the remote module.

In a still further embodiment, one or more of said plurality of second housings can contain signal receiver means for receiving signals from a remote module having a user interface. The signal receiver means can comprise signal receiver circuitry that receives and processes radio frequency signals output by the remote module. In this embodiment, the second housing can contain a power source. In this embodiment, the remote module can house signal transmission circuitry that send radio frequency signals to the second housing in response to adjustments made to the user interface.

In yet another embodiment, one or more of said plurality of second housings can contain signal transceiver means for receiving and sending signals from and to a remote module having a user interface. The signal transceiver means can comprise signal transceiver circuitry that receives and send radio frequency signals from and to the remote module. In this embodiment, the remote module can house signal transceiver circuitry that sends and receives radio frequency signals to and from the second housing in response to adjustments made to the user interface.

In another embodiment, one or more of said plurality of second housings can have a visual display. The visual display can comprise one or more light emitting diodes (LEDs) and/or a liquid crystal display (LCD). The visual display can provide the recipient or their carer with information about the performance of one or more aspects of the prosthesis system. In this embodiment, the second housing can contain a power source.

In yet a further embodiment, one or more of said plurality of second housings can have a user interface that is removably mounted to the second housing. In this embodiment, a plurality of different user interfaces can be connectable to said second housing. In this embodiment, only one user interface would typically be connectable to the second housing at any one time.

In a further embodiment, the remote module can have a visual display. The visual display can comprise one or more light emitting diodes (LEDs) and/or a liquid crystal display (LCD). The visual display can provide the recipient or their carer with information about the performance of one or more aspects of the prosthesis system.

According to a second aspect, the present invention is a hearing prosthesis comprising:

a first housing containing a speech processor that receives signals output by a microphone; and

a second housing removably connectable to the first housing;

wherein a user interface is provided on the second housing that provides control of one or more features of the operation of the speech processor.

In one embodiment of this second aspect, the hearing prosthesis can further comprise a remote module having a further user interface. The further user interface can be removably or non-removably mounted on the remote module. The further user interface of the remote module can control different features of the hearing prosthesis to that mounted on the second housing. In another embodiment, the remote module user interface can control some or all of the same features that are controllable by the user interface on the second housing. In yet another embodiment, the second housing user interface can be rendered partially or fully inoperable when a remote module as defined herein is used in conjunction with the second housing of the hearing prosthesis. In a still further embodiment, the further user interface can be mountable on either the remote module or the second housing. In this case, the recipient can, for example, choose to remove the user interface from the second housing and mount it to the remote module or vice versa. In a still further embodiment, the remote module can have a visual display. The visual display can comprise one or more light emitting diodes (LEDs) and/or a liquid crystal display (LCD). The visual display can provide the recipient or their carer with information about the performance of one or more aspects of the prosthesis.

According to a third aspect, the present invention is a hearing prosthesis comprising:

a first housing containing a speech processor that receives signals output by a microphone; and

a remote module;

wherein a user interface is provided on the remote module that provides control of one or more features of the operation of the speech processor.

In all of the aspects, the first housing containing the speech processor can be provided without any user interface such that any modification of its performance must be performed through the user interface on either the second housing and/or the remote control. In another embodiment of the aspects, one form of a user interface can be

provided on the first housing. In one embodiment, this first housing user interface can control different features of the hearing prosthesis to that mounted on the second housing and/or the remote module. In another embodiment, the first housing user interface can control some or all of the same features that are controllable by the user interface on the second housing and/or the remote module. In yet another embodiment, the first housing user interface, if present, can be rendered partially or fully inoperable when a second housing and/or remote module as defined herein is used in conjunction with the first housing of the hearing prosthesis. In a still further embodiment, the first housing user interface can be removably or non-removably mounted to the first housing.

In a still further embodiment, the user interface of the second housing and/or the remote module can be selected from a range of types of user interfaces that are available for use by the recipient of the hearing prosthesis or the recipient's carer. For example, the user interface of the second housing can be the same or different to that available on a remote module. Where a user interface is present on the first housing, the user interface of the second housing and/or the remote module can be different to that provided on the first housing.

In one embodiment of the second and third aspects, more than one type of second housing can be removably connectable to the first housing. The various types of second housing can vary in the type of user interface that is provided thereon. This allows a recipient and/or their carer to customise the hearing prosthesis by selecting the user interface to be used with their hearing prosthesis at any one time.

In a further embodiment, more than one type of remote module can be used in conjunction with the speech processor. The various types of remote control can vary in the type of user interface that is provided thereon and/or whether a visual display is provided. This allows a recipient and/or their carer to customise the hearing prosthesis by selecting the user interface to be used with their hearing prosthesis at any one time. The hearing prosthesis can rely on one-way or two-way wireless communication between the remote module and the speech processor. In another embodiment, signals can be transmitted from the remote module to the speech processor and/or from the speech processor to the remote module using one or more suitable cables or through a radio frequency transmission system. The user interface can be removably or non-removably mounted to the remote module.

In one embodiment, the user interface can comprise one or more push buttons or switches and/or one or more dials or rotary controls. For example, a user interface can comprise a push button that activates and/or deactivates the speech processor and/or selects the speech processor programme, a dial that allows adjustment of the volume and sensitivity of the speech processor, and a further push button that allows selection of whether input to the speech processor is provided by the microphone, a telecoil or a mixture of inputs.

In another embodiment, the user interface can incorporate at least one tactile position control that, through its position, provides feedback to the recipient and/or their carer as to the setting of that control. In one embodiment, the tactile position control can comprise a switch that is movable between at least two settings. In one embodiment, the user interface can comprise a first three-position switch that allows a recipient and/or their carer to select which speech programme is to be used, a dial that allows adjustment of the volume and sensitivity of the speech processor, and a second three-position switch which allows a recipient and/or their carer to set whether the speech processor is receiving input from the microphone, a telecoil, or a mix of such inputs. The switch can also allow the recipient and/or their carer to adjust the operation of the speech processor such that it can detect relatively softer sounds, such as whispers.

In one embodiment, the user interface can be enclosed within a resiliently flexible cover. The cover can be provided to protect the user interface. In addition or instead, the cover can allow more precise control of the user interface by the recipient and/or their carer.

In one embodiment, and where the hearing prosthesis comprises the second housing, the second housing can contain a power supply for at least some of the components of the prosthesis. In one embodiment, appropriate electrical connection can be made on mounting of the second housing to the first housing so that the power supply can provide power to at least the speech processor of the prosthesis.

In a further embodiment, the first housing containing the speech processor unit can be connectable to more than one type of power supply. Still further, the second

housing can be connectable to the first housing in at least two orientations and/or at least two configurations.

In another embodiment, and where the hearing prosthesis comprises the remote module, the remote module can contain a power supply for at least some of the components of the prosthesis. In one embodiment, appropriate electrical connection can be made between the remote module and the speech processor so that the power supply can provide power to at least the speech processor of the prosthesis.

In one embodiment, the power supply can comprise one or more batteries, including one or more rechargeable batteries.

In one embodiment, and where the prosthesis comprises at least the first housing and the second housing, these components can be positionable on the ear of the recipient. An ear hook can be removably attached to and extend from the first housing to facilitate mounting of the external component of the prosthesis to the ear of the recipient. In another embodiment, these components can be adapted to be worn on the body, such as by being clipped to or placed in the pocket of clothing being worn by the recipient.

Where the prosthesis relies on use of the remote module, the remote module can be worn on the body, such as by being clipped to or placed in the pocket of clothing being worn by the recipient.

In one embodiment, the speech processor can receive signals output from a microphone that is mounted on or within the first housing. In another embodiment, the speech processor can receive signals from a microphone that is mounted on the remote module. Still further, the speech processor can receive signals from more than one microphone.

In a further embodiment, the hearing prosthesis can be a cochlear implant system. In this embodiment, the speech processor comprises part of the external component of such a system. A cable can extend from the first housing to a headpiece that is typically worn on the head of the recipient. The headpiece can comprise an antenna that is capable of transmitting signals to a complementary antenna implanted

within the recipient. In addition, the external antenna can be capable of receiving signals transmitted from the implanted antenna.

The external antenna can comprise an antenna coil and be part of a transcutaneous radio frequency (RF) link between an external component of the cochlear implant hearing system and an implanted component thereof. The coil can surround a magnet that is attracted to a complementary magnet implanted within the recipient. The magnetic attraction can serve to retain the external antenna, during use, in the desired position on the head of the recipient.

In a still further embodiment, the first housing and/or the second housing can be formed of a metallic material, a ceramic material, a polymeric material, or some combination thereof. It will be appreciated that the first housing could be formed of a different material, or the same material, to that used for the second housing.

The external component of the cochlear implant is designed to operate in conjunction with an implantable component. The implantable component comprises a housing for a stimulator unit that outputs stimulation signals based on inputs delivered from the external speech processor, a receiver antenna that is part of the RF link, and an electrode assembly that applies electrical stimulation to the cochlea in accordance with the output of the stimulator unit.

Brief Description of the Drawings

By way of example only, preferred embodiments of the invention are described with reference to the accompanying drawings, in which:

Fig. 1 is a side elevation view of one embodiment of an external component of a hearing prosthesis according to the present invention;

Fig. 2 is a side elevation view of another embodiment of an external component of a hearing prosthesis according to the present invention;

Fig. 3 is a view of another embodiment of an external component of a hearing prosthesis according to the present invention; and

Fig. 4 is a schematic view of one embodiment of a hearing prosthesis system according to the present invention.

Preferred Mode of Carrying out the Invention

One embodiment of an external component of a cochlear implant system according to the present invention is depicted generally as 10 in Fig. 1.

The component 10 can be worn on the ear of a recipient of the implant system. The component 10 has a first housing 11 containing speech processor circuitry that receives signals output by a microphone. Extending forwardly from the first housing 11 is an ear hook 12. The depicted ear hook 2 is removably attached to the first housing 11. The microphone can be mounted on the housing 11 or be positioned at another location.

The component 10 also comprises a second housing 13 that is also removably connectable to the first housing 11. The second housing 13 has a user interface mounted thereon (depicted generally as 14) that provides control of certain features of the operation of the speech processor within the first housing 11. In the depicted embodiment, the user interface 14 is non-removably mounted to the second housing 13. It will be appreciated that the user interface 14 could be removably mounted to the second housing 13.

In the embodiment depicted in Fig. 1, the user interface 14 comprises two push buttons (15,16) and a dial 17. Push button 15 is used to activate and deactivate the speech processor within the first housing 11 and is also used to select the speech processor programme being performed by the speech processor. The dial 17 allows adjustment of the volume and sensitivity of the speech processor while the push button 16 allows the recipient or their carer to select whether the input to the speech processor is provided by the microphone, a telecoil or a mixture of inputs.

An alternative embodiment of the external component is depicted generally as 20 in Fig. 2.

The component 20 can also be worn on the ear of a recipient of the implant system. The component 20 again has a first housing 11 containing speech processor

circuitry that receives signals output by a microphone, and a removably attachable ear hook 12.

The component 20 also comprises a second housing 23 that is also removably connectable to the first housing 11. The second housing 23 has a different user interface mounted thereon (depicted generally as 24), to that depicted in Fig. 1, that provides control of certain features of the operation of the speech processor within the first housing 11. In the depicted embodiment, the user interface 24 is non-removably mounted to the second housing 23. It will be appreciated that the user interface 24 could be removably mounted to the second housing 23.

In the embodiment depicted in Fig. 2, the user interface 24 comprises two tactile position controls (25,26) that, through their position, provide feedback to the recipient and/or their carer as to the setting of that control. Both tactile position controls (25,26) comprise a switch that is movable between at least three settings. Switch 25 is a three-position switch that allows a recipient and/or their carer to select which speech programme is to be used. Dial 27 allows adjustment of the volume and sensitivity of the speech processor. Switch 26 allows a recipient and/or their carer to set whether the speech processor is receiving input from the microphone, a telecoil, or a mix of such inputs. The switch 26 also allows the recipient and/or their carer to adjust the operation of the speech processor such that it can detect relatively softer sounds, such as whispers.

In Fig. 2, the user interface 24 is enclosed within a resiliently flexible cover 28. The cover 28 protects the user interface 24 but also allows more precise control of the user interface 24 by the recipient and/or their carer.

In the embodiments depicted in Figs. 1 and 2, the first housing for the speech processor 11 is provided without any user interface such that any modification of its performance must be performed through the user interface on the second housing (13 or 23).

As is depicted by Figs. 1 and 2, more than one type of second housing can be removably mountable to the first housing 11. The various types of second housing can vary in the type of user interface that is provided thereon. This allows a recipient

and/or their carer to customise the hearing prosthesis by selecting the user interface to be used with their hearing prosthesis at any one time.

In the embodiments depicted in Figs. 1 and 2, the second housing (13 or 23) contains a power supply for powering the componentry of the prosthesis. On mounting of the second housing (13 or 23) to the first housing (11), the power supply is able to provide power through an appropriate electrical connection to the speech processor. In the depicted embodiment, the power supply within the second housing comprises one or more rechargeable batteries.

A still further embodiment of an external component of a cochlear implant system is depicted generally as 30 in Fig. 3. In this embodiment, the speech processor 31 can be used in conjunction with a remote module 32. In the depicted embodiment, the speech processor can be used in conjunction with a range of different remote modules having different user interfaces thereon. This allows a recipient and/or their carer to customise the hearing prosthesis by selecting the user interface to be used with their hearing prosthesis at any one time.

In the depicted embodiment, the component 30 relies on use of a cable 33 that provides data and power transfer between the remote module 32 and a connector unit 31a that is removably connectable with the speech processor 31. It will be appreciated that wireless transmission could be utilised to transfer data and control signals between the remote module 32 and the speech processor and/or vice versa.

In Fig. 3, the depicted speech processor 31 is provided without a user interface and instead the remote module 32 has a user interface 34. The user interface comprises, in the depicted embodiment, two push-button switches and a dial similar to that of user interface 14 described herein. In the depicted embodiment, the user interface 34 is non-removably mounted to the remote module 32. It will be appreciated that the user interface could be removably mounted to the remote module 32. It will be appreciated that alternative user interface types could be provided on the remote module 32 or on different remote modules used in conjunction with the speech processor 31.

In the embodiment depicted in Fig. 3, the remote module 32 also houses a power supply for the componentry of the external component 30. In the depicted embodiment, the power supply comprises two rechargeable batteries 35.

The remote module 32 can be worn on the body of the recipient, such as by being clipped to or placed in the pocket of clothing being worn by the recipient.

It will be appreciated that the remote module 31 could also be used in conjunction with the components 10 and 20 depicted in Figs. 1 and 2, respectively.

As is depicted in Fig. 3, a cable 36 extends from the first housing to a headpiece 37. Such a cable and headpiece can also be used in conjunction with the embodiments depicted in Figs. 1 and 2. The headpiece 37 comprises an antenna coil 38 that is capable of transmitting signals to a complementary antenna implanted within the recipient. In addition, the depicted external antenna coil 38 is capable of receiving signals transmitted from the implanted antenna. The coil 38 surrounds a magnet 39 that is attracted to a complementary magnet implanted within the recipient. The magnetic attraction serves to retain the external antenna coil 38, during use, in the desired position on the head of the recipient.

As is depicted by Fig. 4, the external component 30 of Fig. 3 can be part of a hearing prosthesis system 40. In the system 40, the recipient or their carer is provided with a number of options as to what may be connected to the speech processor 31 housing at any one time.

As depicted, the system can incorporate a second housing depicted as housing 41. This second housing 41 houses a power supply 42 and radio frequency signal receiver circuitry that receives and processes radio frequency signals output by the remote module 32. In this embodiment, the remote module 32 incorporates radio frequency signal transmission circuitry that transmits signals to the housing 41 in response to adjustments made to the user interface 34 on the remote module 32.

The system can also incorporate a further second housing depicted as housing 43. This housing houses a power supply and also has a visual display device 44 and user interface 45 provided thereon. The depicted display device 44 is a liquid crystal display, however, other suitable displays can be envisaged. The liquid crystal display

44 provides feedback to the recipient or their carer as to the performance of the system 40.

It will be noted that the system 40 could also incorporate the housing 23 as is depicted by Fig. 2 having a tactile user interface 24.

The system can also incorporate a further second housing depicted as housing 46. This housing houses a power supply and circuitry that not only receives and processes radio frequency signals but also can transmit signals back to a remote module, here depicted as 47. In this case, the remote module 47 as well as housing a power source has a user interface 48 and a liquid crystal display (LCD) 49. The liquid crystal display 49 provides feedback to the recipient or their carer as to the performance of the system 40.

The external component of the cochlear implant is adapted to operate in conjunction with an implantable component. The implantable component comprises a housing for a stimulator unit that outputs stimulation signals based on inputs delivered from the external speech processor, a receiver antenna coil, and an electrode assembly that applies electrical stimulation to the cochlea in accordance with the output of the stimulator unit.

It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

Dated this twenty second day of December 2003

Cochlear Limited
Patent Attorneys for the Applicant:

F B RICE & CO

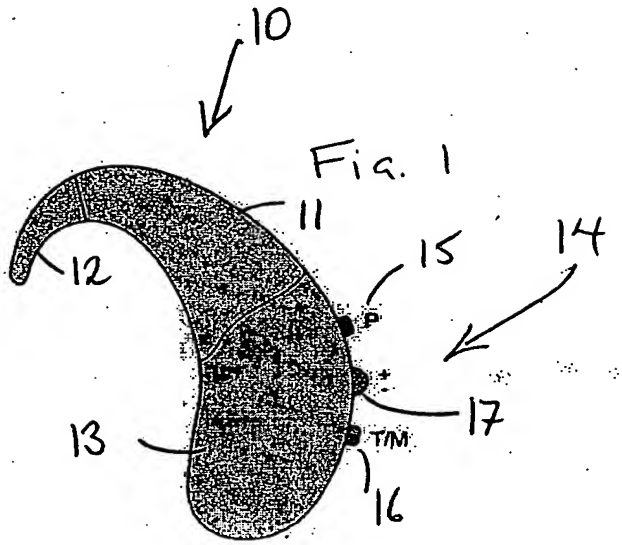

Fig. 1

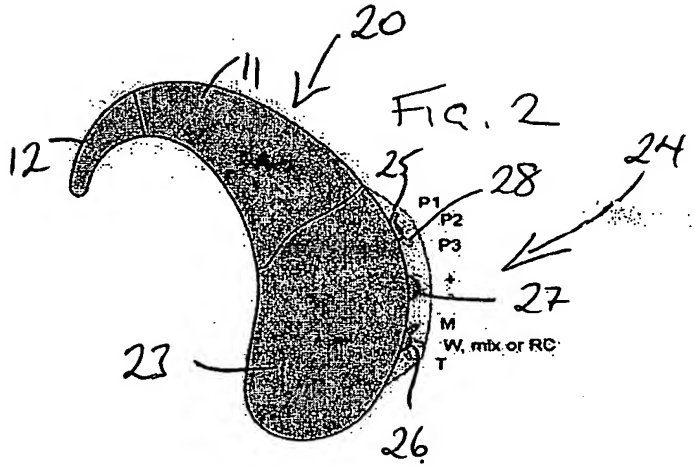

Fig. 2

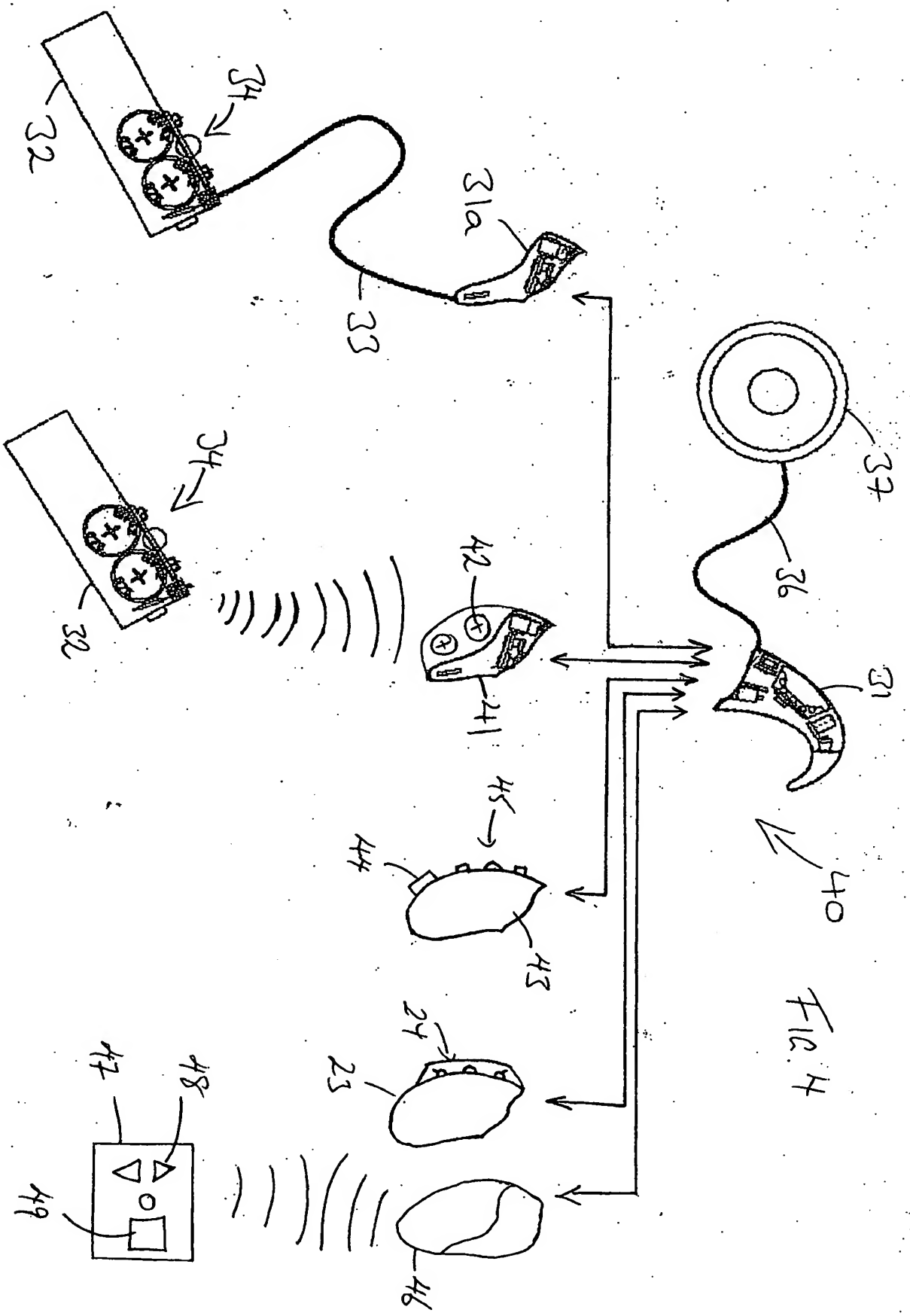

FIG. 4

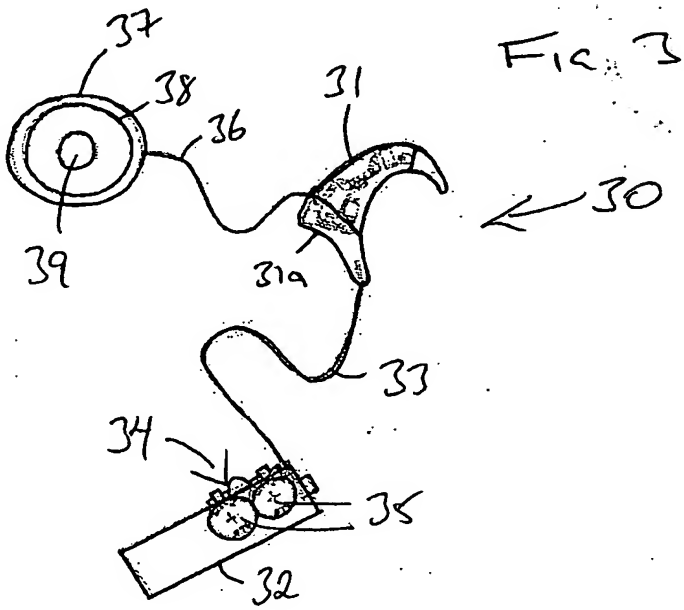

Fig. 3